BULK STORAGE OF SALT AND SAND/SALT MIXTURES

May 1978

Ontario
Ministry of the Environment

Ontario
Ministry of Transportation and Communications

BULK STORAGE OF SALT
AND SAND/SALT MIXTURES

May 1978

Contamination Committee

Ministry of the Environment

Ministry of Transportation
and Communications

BULK STORAGE OF SALT AND SAND/SALT MIXTURES

INTRODUCTION

This document has been prepared by the Contamination Committee of the Ministries of Transportation and Communications (MTC) and Environment (MOE). It is expressly designed to deal with contamination caused by the "leaching" of salt from uncovered or unprotected sand/salt stockpiles. ("Leaching" means the extraction of soluble salts by percolation of water through stockpiles.)

The purpose of this document is simply to define the problem and suggest remedies as aids to those road authorities which make use of such stockpiles.

THE PROBLEM

All unprotected salt and sand/salt stockpiles can contaminate ground and surface waters and kill vegetation.

Rainfall leaches the salt from the stockpile and this brine solution moves downslope until it infiltrates and/or flows into surface streams. Infiltrated brine mixes with the ground water and moves downgradient from the pile. As it moves, it may contaminate water wells and kill deep-rooted vegetation. (See Fig. 1)

Damages and costs involved in restoring contaminated ground waters are generally very high. For example, there are North American cases on record, where restoration costs have amounted to many times the costs of proper storage facilities. The Province of Ontario, therefore, is increasing its efforts to control contamination caused by the bulk storage of salt and sand/salt mixtures.

The MOE and the MTC have received many complaints from residents who live in the vicinity of stockpiles about salt-contaminated wells and/or vegetation kills. In 1974-75 the MOE Regional Offices were involved in eight separate ground-water contamination cases in which the probable sources of contamination were unprotected salt or sand/salt storage piles. Nine more cases were investigated in the 1975-76 period.

This problem is not restricted to Ontario but occurs also in other parts of Canada and in the United States. Some of the States in the U.S.A. have, in fact, found it necessary to enact regulations governing the bulk storage of deicing compounds in an effort to prevent this form of contamination. In Ontario, the Environmental Protection Act, promulgated in 1971, seeks to prevent the contamination of the "natural environment", meaning the land, the water and the air.

In dealing with alleged contamination cases, following an initial complaint by a well owner, MOE Regional staff undertake a hydrogeological investigation in an effort to identify positively the type and source of the contaminant. Where the source of the

contaminant is established to be a bulk-storage pile, the owner of the pile is informed of the findings and asked to take corrective measures to eliminate the source of contamination and provide a water supply.

It should be emphasized that the natural rehabilitation of contaminated ground water may, depending on hydrogeologic conditions, require many years. Even after a stockpile is removed, the problem will remain for some time because some salt will have been held by the soils underlying the original site and this salt will continue to be leached into the ground water by rain or melted snow.

THE REMEDY

While it is acknowledged that it can take years to eliminate contamination caused by the leaching of salt from stockpiles, it is nevertheless an urgent necessity that a start be made to eradicate, or at least control, the problem. The MTC, Ontario's largest user of sand/salt mixtures for winter road maintenance, has been grappling with the situation for years. That Ministry spends considerable sums of money in trying to prevent and correct environmental damage caused by the leaching of salt from sand/salt stockpiles at MTC patrol yards.

As a result of extensive study and research, the MTC believes that in most cases, the most effective solution is to "house" the stockpiles or, in other words, cover them completely. For this reason, the MTC began some time ago experimenting with various types of storage structures but reached the conclusion that a dome-type structure is the most practical and satisfactory. (For MTC experience with different types of coverings and storage structures see Appendix).

Over a number of years, MTC has engaged in a continuing program of building storage domes at their patrol yards on a priority basis. To date, approximately 200 of these domes have been erected. (Two types of domes are illustrated in figures 2 and 3).

BENEFITS

Apart from the primary purpose of preventing or controlling contamination, it has been MTC's experience that there are many other benefits to be derived from using permanent coverings over sand/salt piles. For instance:

(a) Losses by leaching and erosion from sand/salt piles are eliminated since the piles are protected from precipitation.

    Unprotected stockpiles of "treated sand" (a mixture of sand and salt) can lose up to 40 percent of their salt content by exposure to the elements so that "sweetening" (adding extra salt) is required to bring leached piles up to the salt/sand proportions necessary for effective winter road maintenance.

(b) The wind-blown drifting of salt and salt-coated sand is also eliminated.

(c) The sand/salt mixture does not cake, thus it is easier and faster to load and spread.

(d) Less maintenance is required on the sander hoppers because of the free-flowing characteristics of a sand/salt mixture from a covered pile. When caked material is encountered, operators must break it up with steel bars, shovels etc. in order for the mixture to pass freely through the equipment. Such treatment results in damage to the protective coating system and necessitates more frequent repair and painting.

(e) Some operators have been injured by falling from sanders during storms when attempting to free lumps etc. in the equipment.

(f) Operators appreciate the convenience of a shelter for loading.

(g) Housing of sand/salt storage piles is aesthetically pleasing both to the neighbourhood and the travelling public.

CONCLUSION

As indicated in the Introduction, the foregoing is intended to deal with contamination associated with the leaching of salt from stockpiles and to illustrate, very briefly, the steps which the Province has taken to deal with the situation.

The joint MOE - MTC Contamination Committee recommends that Municipalities give this document their earnest consideration and take action to control such contamination.

You may obtain advice on avoiding contamination by proposed or existing storage areas from the Ground Water Evaluators in the Ministry of the Environment's Regional Offices. Advice on covering storage areas is available from the Regional or District offices of the MTC.

APPENDIX

MTC Experience with Different Types of Coverings
and Storage Structures
For Sand/Salt Stockpiles

1. Standard Salt Sheds

This type of structure has been used by MTC for several decades and because the salt is completely covered, there have been no leaching problems.

The low clearance of these structures however, causes difficulties in unloading large trucks.

In an effort to overcome this problem, two experimental sheds equipped with sliding roofs were built some years ago. While these proved excellent for unloading, they were expensive and the project was abandoned.

2. "Ground" Storage

There was a time when sand/salt mixtures were simply piled on level ground with no thought being given to possible contamination from this rather casual method of storage. However, due to the rain and snow falling on the exposed pile and the action of such equipment as trucks and loaders, the base of the pile often became a soggy mess. The amount of wastage of treated sand because of this contamination by water, mud and stones, led the MTC to consider corrective measures.

3. Asphalt Pads

In the early 1950's, the MTC began experimenting with paved or asphalt pads as a base on which to stockpile treated sand. This was a great improvement as it provided an excellent surface where equipment could operate without contaminating the bottom portion of the pile or wasting any of the treated sand. By the mid 1950's, asphalt pads were being constructed on a wide scale at MTC patrol yards across the Province.

4. Sumps

While asphalt pads reduced wastage of treated sand directly into the soil and tended to confine contamination to a localized area, there remained the problem of run-off from the exposed sand/salt stockpiles. In order to control this, the MTC, in the early 1960's, installed sumps to collect the run-off, but the disposal of the brine collected from the sumps posed another problem. Frequent pumpings involved time, labour and expense, and brine disposal sites were extremely difficult to find.

In addition, concave or bermed pads which collected the run-off made the work area wet and the sand/salt mixture difficult to handle.

The use of sumps for control of contamination was abandoned in the early 1960's as an impractical and uneconomical method.

5. Temporary Coverings

To minimize percolation of precipitated moisture through sand/salt piles, canvas and polyethylene tarpaulins were used at one time to cover treated sand.

This method was soon found to be impractical. Such coverings were difficult and sometimes dangerous to put up, particularly in high wind; they were also difficult to remove as they were often laden with ice and snow. Moreover, it was found that tarpaulins could be easily damaged or torn by loading equipment with pieces getting into the sanders and causing further problems.

Another type of covering which proved moderately successful, and is still being used to some extent, is a plastic coating sprayed over the surface of the pile. The material used for this is an emulsion of Curasol A-H which, when mixed with water, can be applied by MTC mobile weed sprayers over the surface of the pile.

The advantages of Curasol A-H are: (a) relatively inexpensive, (b) easy to apply, (c) no problems when loading or spreading as the material breaks easily.

The disadvantages of Curasol A-H are: (a) difficult to obtain uniform coating, (b) easily damaged by children and animals, (c) working face of the stockpile is not protected.

The Curasol A-H emulsion method is used by the MTC only as a temporary expedient, not as a permanent solution.

Regardless of the type of temporary covering, the major drawback is that complete protection of the stockpile is not achieved as the working face of the pile remains constantly exposed.

6. Storage Bins

Three-sided storage bins were used in the mid 1960's at about the same time removable coverings were being investigated. They were relatively inexpensive, easy to build and easy to cover. Eight-inch by eight-inch posts set in concrete were used, with metal sheeting or wooden planking in between the posts.

The bins made of lumber were more durable than those made of metal; however, there were operational difficulties with both types. The face of treated sand, being exposed to the elements, froze into large lumps which made the loading of sanders extremely difficult. Removable coverings, as indicated above, also presented operational problems.

The use of bins was discontinued after a short trial period.

7. Permanent Coverings

Simultaneously with all these other experiments, the MTC explored the relative merits of various types of permanent coverings such as:

(a) Daren Dome, which is basically a wooden frame covered by a polyethelene skin.

(b) Quonsets.

(c) Air-inflated coverings.

(d) Silo-type structures.

It was found, however, that the cost of storage per cubic yard of treated sand in any of these structures was generally prohibitive.

By the mid 1960's, the MTC became interested in other dome-type structures for covering or protecting sand/salt stockpiles. Two of these, in particular, were the "Western Dome" (see Fig. 2) and the "Fitzpatrick Dome" (Fig. 3).

8. "Western Dome" Structure

This is a pre-fabricated structure manufactured by Engineering Buildings of Calgary, Alberta and is "half-ball" in shape.

Reports indicated that treated sand from this structure was easy to handle and worked well in sanding operations on the road. It was filled by conveyors and/or loaders.

"Western Domes" were built to different specifications depending on individual requirements, for instance, approximately 50 feet, 80 feet or 100 feet in diameter, with storage capacities of about 1,000, 2,400 or 3,300 cubic yards, respectively.

Between 1966 and 1968, MTC erected 4 of these pre-fabricated domes. One of these, 80 feet in diameter, mounted on wooden posts, cost approximately $12,000 in 1967.

Owing to rapidly spiralling costs, it was decided to abandon the Western Dome and to concentrate on the Fitzpatrick Dome with which the MTC were also experimenting at that time.

9. Fitzpatrick Dome Structure

This dome was designed by a former MTC employee who had it patented. Bulk Store Structures Ltd., Hillsburg, Ontario

presently hold the patent rights in Canada. The MTC and other jurisdictions receiving provincial government subsidies toward its construction are permitted to construct this dome without paying any royalty to the holder of the patent.

This dome is basically a 20-sided conical shell constructed of 3/8" plywood and 2" x 6" lumber. It is designed to accommodate sand piled at a 45° angle. Sand/salt mixtures are prevented from touching the outer skin by means of an interior wooden wall about 4 feet high.

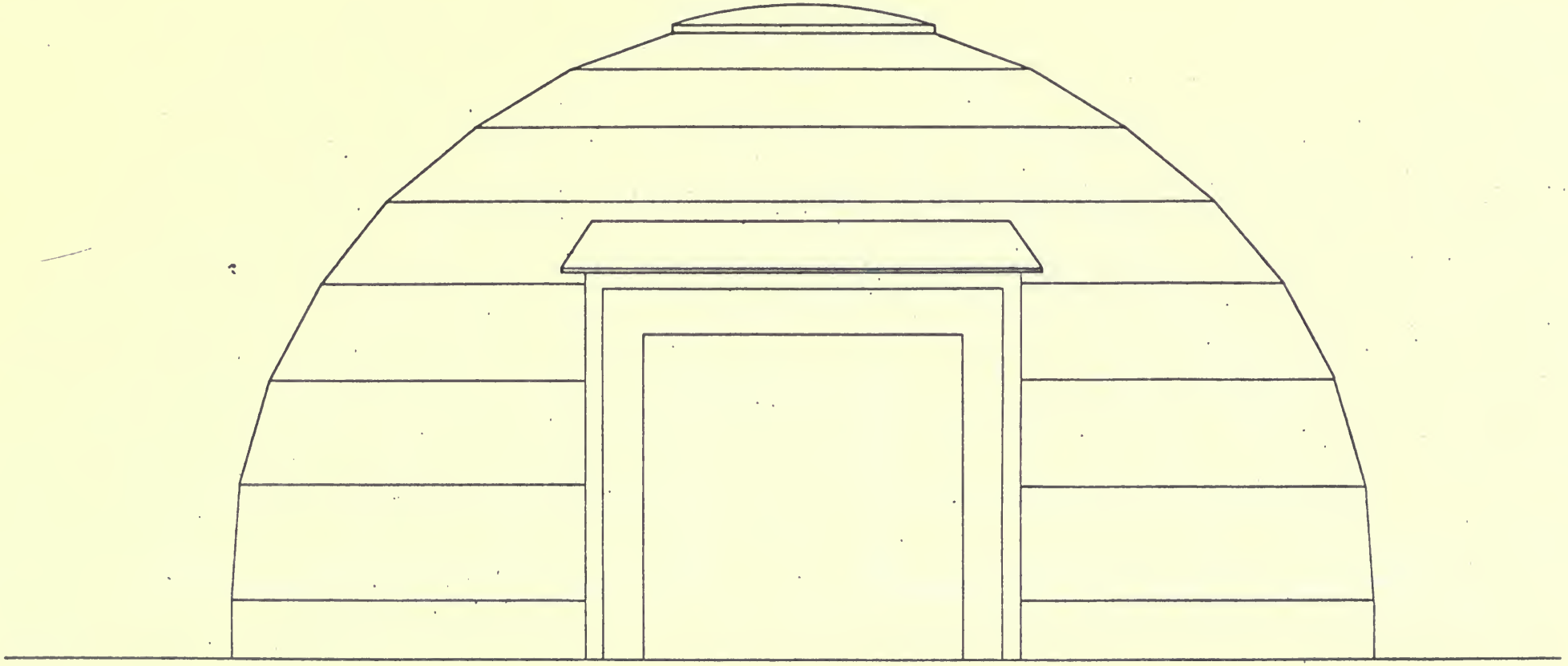
The majority of these domes are 100 feet in diameter and approximately 50 feet in height but because the superstructure is prefabricated, larger or smaller domes can be erected simply by adding or deleting lower rings.

MTC's first practical experience with this type of structure was in 1968 when a 100-foot Fitzpatrick Dome was built on a trial basis at a cost of approximately $17,000. The experiment was so successful that from 1968 to 1977, approximately 200 Fitzpatrick Domes were erected at various MTC patrol yards throughout the Province. Labour and material costs, of course, have steadily risen since 1967 and the figure of $30,000 is now generally used in estimating the cost of a completed Fitzpatrick Dome.

There are many factors governing costs that vary considerably from location to location. Shipping costs, type of sub-base, stability of sub-base, to mention a few, have all to be taken into account, so that costs can vary from about $25,000 to $40,000.

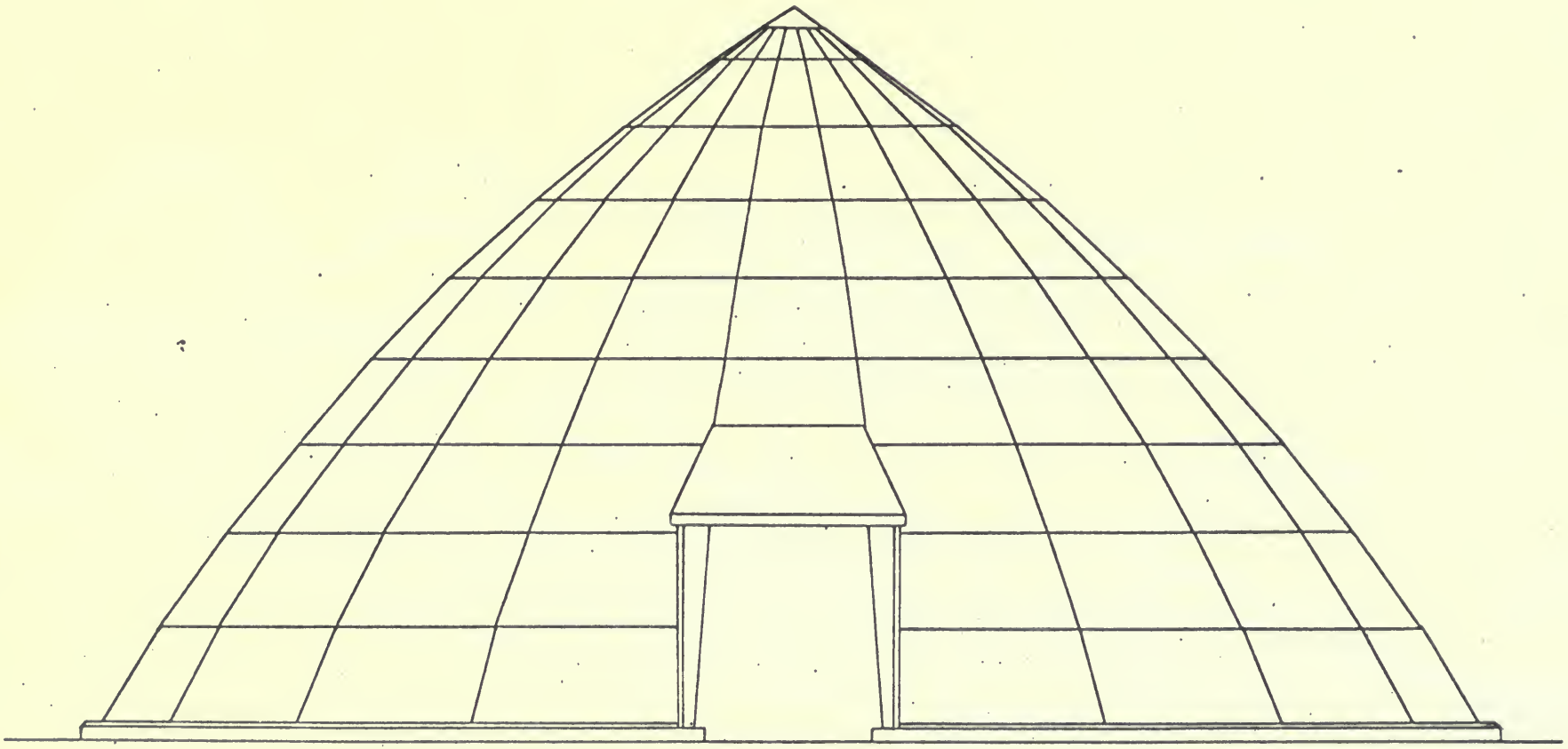
After experimenting with various other types of structures, it is the conviction of the MTC that none of the others used to date are as economical or practical as the Fitzpatrick Dome. MTC is continuing to explore the possibilities of improving the Fitzpatrick Dome design to reduce costs and at the same time retain or increase the capacity of the structure.

FIGURE 2



WESTERN DOME

FIGURE 3



FITZPATRICK DOME

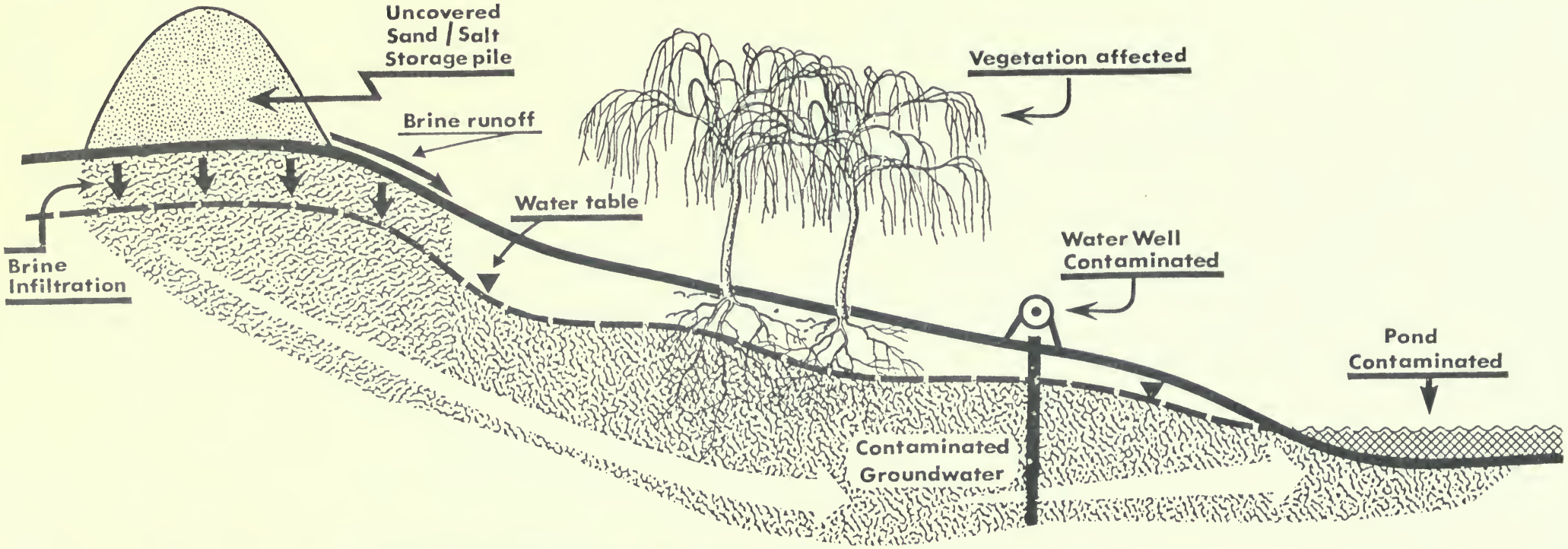


FIG.1. GROUND & SURFACE WATER CONTAMINATION FROM UNCOVERED SAND / SALT STORAGE